Infaunal Community Differences in Caloric Content in the Northeastern Chukchi Sea

Steven Savard*, Arny Blanchard, Kelley Tu
Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, AK
*email: ssavard@alaska.edu

Introduction

Energy-rich, sediment-dwelling organisms support large populations of benthic-feeding predators in the northeastern Chukchi Sea. Sediment caloric content (caloric content of fauna living in sediments) can vary with environmental characteristics (Griffiths 1977). Thus, determination of the key environmental covariates with caloric content of prey items in sediments is important for understanding spatial variations in benthic food webs and predator distributions.

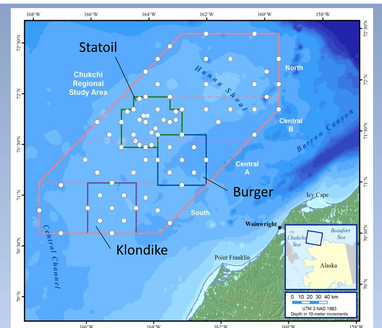

Figure 1. Stations sampled for benthic fauna during the 2011 CSESP in the northeastern Chukchi Sea. The large polygon represents the Chukchi Regional Study Area, while smaller boxes represent the three main study areas; Klondike, Burger, and Statoil.

Methods

Sampling

- Infaunal biomass samples were collected from 74 stations in 2011 during the Chukchi Sea Environmental Studies Program (CSESP: Figure 1).
- Environmental samples were also collected in 2011 including % mud, water depth (m), bottom-water temperature (C), & total chlorophyll (pg cm^{-3})
- Infaunal caloric samples were collected from van Veen grabs in 2009-2011.
  - Biomass and tissue caloric content combined to determine caloric content of *Ennucula tenuis* & *Macoma* spp. in sediments of the CSESP study area.

Statistical Analyses:

- Geostatistical analysis was performed to model spatial variation in sediment caloric content, water depth, & bottom-water temperature over the CSESP regional study area.
- Multiple linear regression was used to test significance of relationships between sediment caloric content and environmental variables.

Spatial models

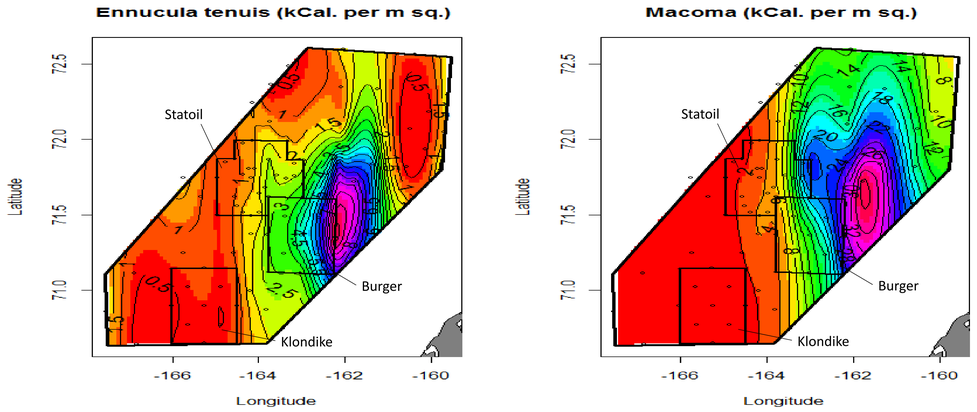

Figure 2: *Ennucula tenuis* and *Macoma* spp. caloric content in sediments in the CSESP study area, 2011. Red indicates areas of low caloric content while blue/violet are areas of high caloric content

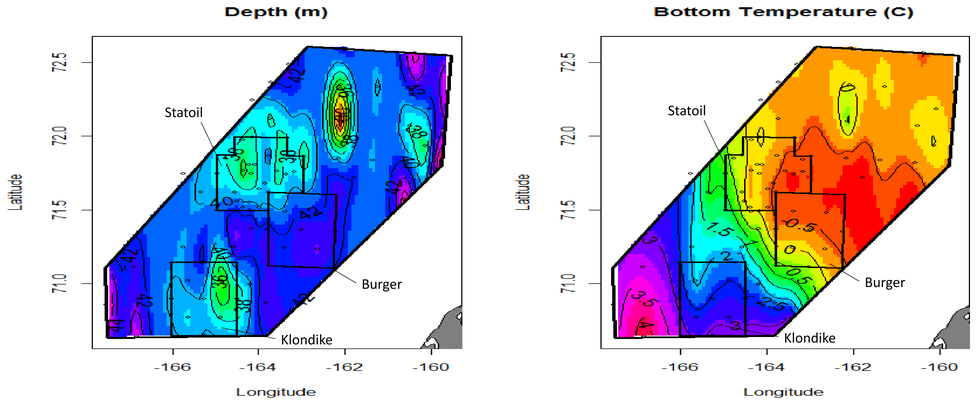

Figure 3: Water depth and bottom-water temperature in the CSESP study area, 2011. Red indicates shallower depths and lower temperatures while blue/violet are deeper depths and higher temperatures.

Caloric Content of Bivalves in Sediments

- Caloric content of *E. tenuis* and *Macoma* spp. was highest in sediments along the eastern side of Burger and lowest in the southern region (Figure 2).
- *Macoma* spp. have the highest sediment caloric content of the two bivalves, with a maximum value of 127 kCal m^{-2}.

Environmental Variables

- Depth was greatest in the southwest and to the east of the study region (Figure 3).
- Bottom-water temperature was highest in the south west and lowest in the northeast.

Linear Regression

Table 1: Multiple linear regression of *Ennucula tenuis* and *Macoma* spp. sediment caloric contents with environmental variables. Numbers in red are significant ($\alpha = 0.05$). Biological data were log transformed. R^2 depicts the adjusted R-squared for each model.

Table of P values

	Ennucula tenuis	Macoma
% Mud	0.071000	0.719000
Depth (m)	**0.000366**	0.212000
Bottom Temperature (C)	**0.002250**	**0.000003**
Total Chl (pg/cm3)	0.469000	0.399000
R^2	0.198800	0.257800

Regression

- Bottom-water temperature is a significant predictor of caloric content for both bivalves (Table 1).
- Depth is a significant predictor of caloric content of *Ennucula tenuis*.
- *Ennucula tenuis* sediment caloric content is negatively correlated with temperature (r= - 0.285), but positively correlated with depth (r= 0.324).
- *Macoma* spp. sediment caloric content is also negatively correlated with temperature (r= -0.510).

Conclusions

- Caloric content of sediments covaried with water depth and bottom-water temperature.
  - Reduced water circulation in and adjacent to Burger results in higher sediment organic carbon content and greater benthic abundance and biomass (Blanchard et al., in submission; Weingartner et al., in submission).
  - The greater biomass, and thus total caloric content of bivalves in sediments, in and near Burger indirectly reflects topography control over water circulation (Blanchard et al., in submission).
- Areas with high caloric content are also noted as sites of walrus feeding activity (Aerts et al., in submission; Hannay et al., in submission) indirectly linking topographic control to marine mammal activities through distributions of benthic fauna.

References

Aerts, L.A.M., McFarland, A., Watts, B., Lomac-MacNair, K., Seiser, P., Wisdom, S., Kirk, A., Schudel, C., in submission. Marine mammal distribution and abundance in the offshore northeastern Chukchi Sea during the open water season. Continental Shelf Research.

Blanchard, A.L., Parris, C.L., Knowlton, A.L., Wade, N.R., in submission. Benthic ecology of the northeastern Chukchi Sea Part I: Environmental characteristics and macrofaunal community structure, 2008–2010. Continental Shelf Research.

Griffiths, D. (1977) Caloric variation in Crustacea and other animals. Animal Ecology 46 (2) 593-605.

Hannay, D., Delarue, J., Mouy, X., Leary, D., Oswald, J., Vallarta, J., Martin, B., in submission. Marine mammal acoustic detections in the northeastern Chukchi Sea, September 2007-July 2011. Continental Shelf Research.

Weingartner, T., Dobbins, E., Danielson, S., Potter, R., Statscewich, H., Winsor, P., in submission. On the hydrographic variability of the northeast Chukchi Sea shelf in summer-fall 2008 – 2010. Continental Shelf Research.

Acknowlegments
ConocoPhillips, Shell Exploration and Production Company, and Statoil USA E&P, Olgoonik Fairweather LLC, the crews of the *M/V Bluefin* (2008) and *M/V Westward Wind* (2009 – 2011), Aldrich Offshore Services, Olgoonik Oilfield Services.